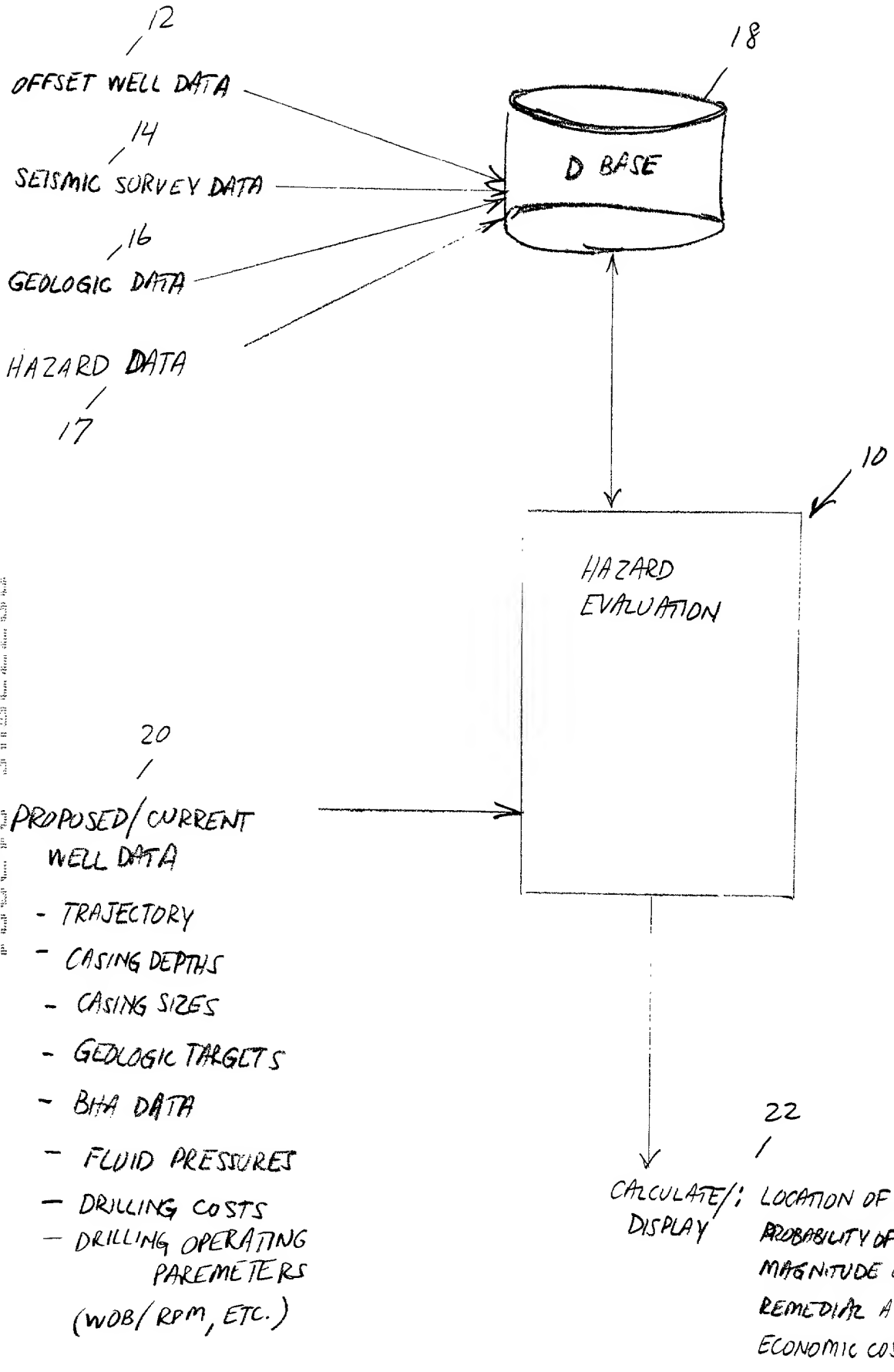
12
OFFSET WELL DATA
14
SEISMIC SURVEY DATA
16
GEOLOGIC DATA
HAZARD DATA
17
18
D BASE
10
HAZARD EVALUATION
20
PROPOSED/CURRENT WELL DATA
- TRAJECTORY
- CASING DEPTHS
- CASING SIZES
- GEOLOGIC TARGETS
- BHA DATA
- FLUID PRESSURES
- DRILLING COSTS
- DRILLING OPERATING PAREMETERS (WOB/RPM, ETC.)
22
CALCULATE/DISPLAY
LOCATION OF HAZARD
PROBABILITY OF HAZARD
MAGNITUDE OF HAZARD
REMEDIAL ACTION TO REMEDY
ECONOMIC COST OF HAZARD

FIG 1

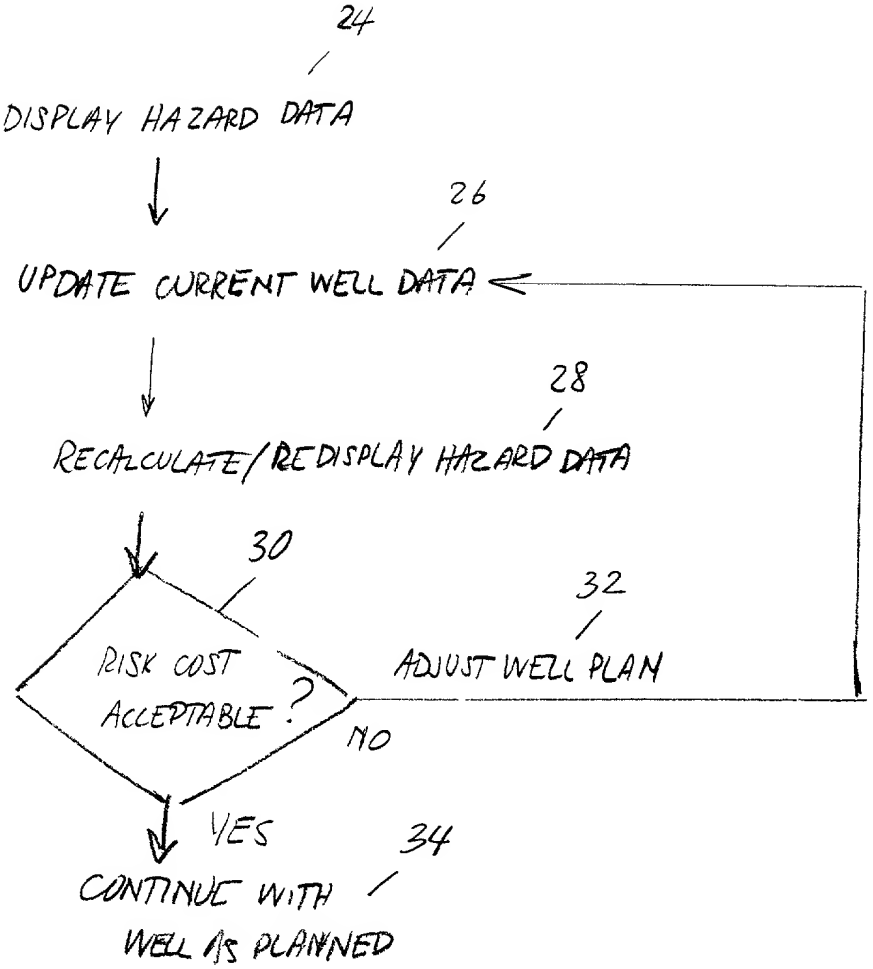
24
DISPLAY HAZARD DATA
26
UPDATE CURRENT WELL DATA
28
RECALCULATE/REDISPLAY HAZARD DATA
30
RISK COST ACCEPTABLE ?
NO
32
ADJUST WELL PLAN
YES
34
CONTINUE WITH WELL AS PLANNED

FIG 2

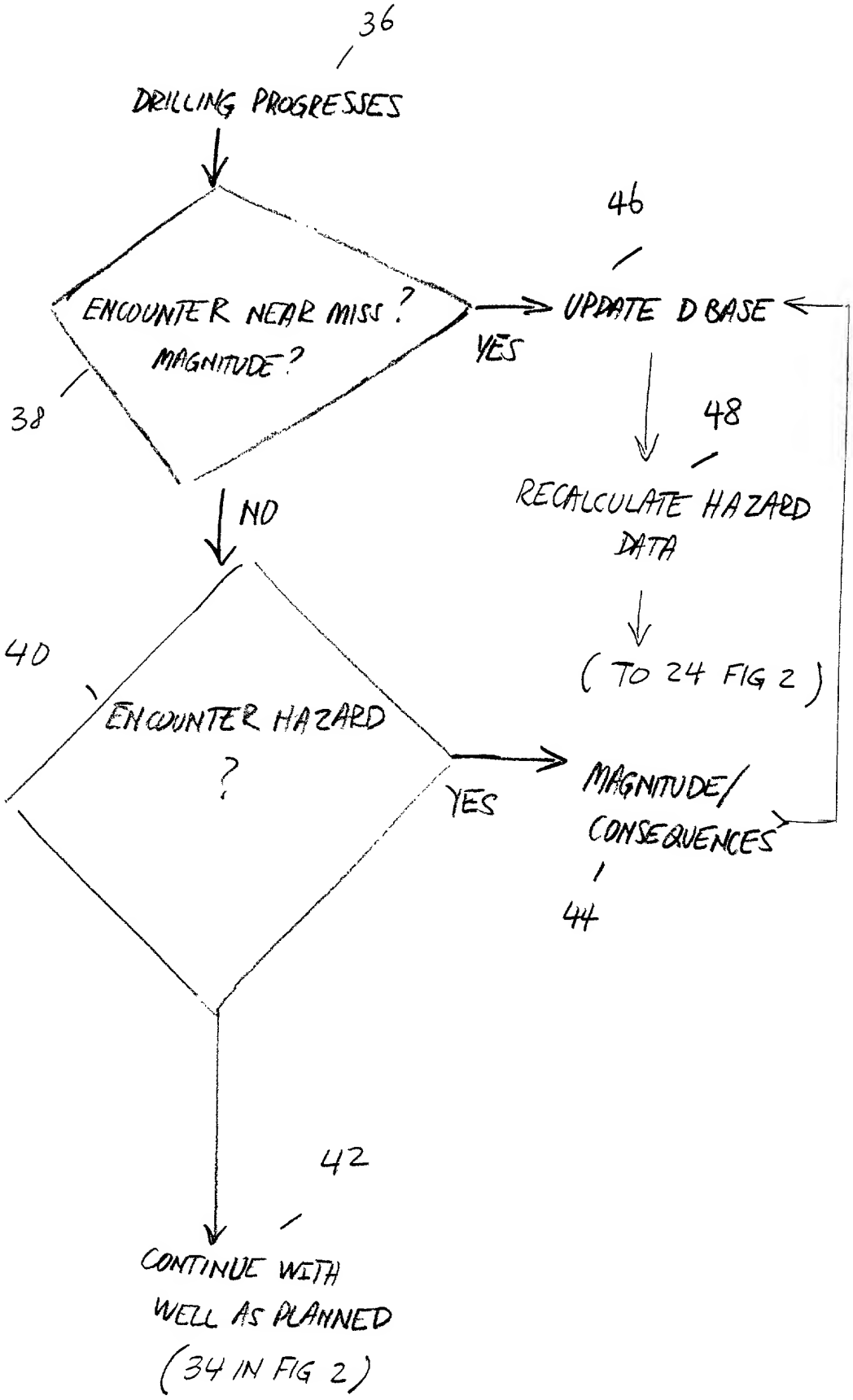
36
DRILLING PROGRESSES
ENCOUNTER NEAR MISS ?
MAGNITUDE ?
38
YES
46
UPDATE D BASE
48
RECALCULATE HAZARD DATA
(TO 24 FIG 2)
NO
40
ENCOUNTER HAZARD ?
YES
MAGNITUDE/ CONSEQUENCES
44
42
CONTINUE WITH WELL AS PLANNED
(34 IN FIG 2)

FIG 3

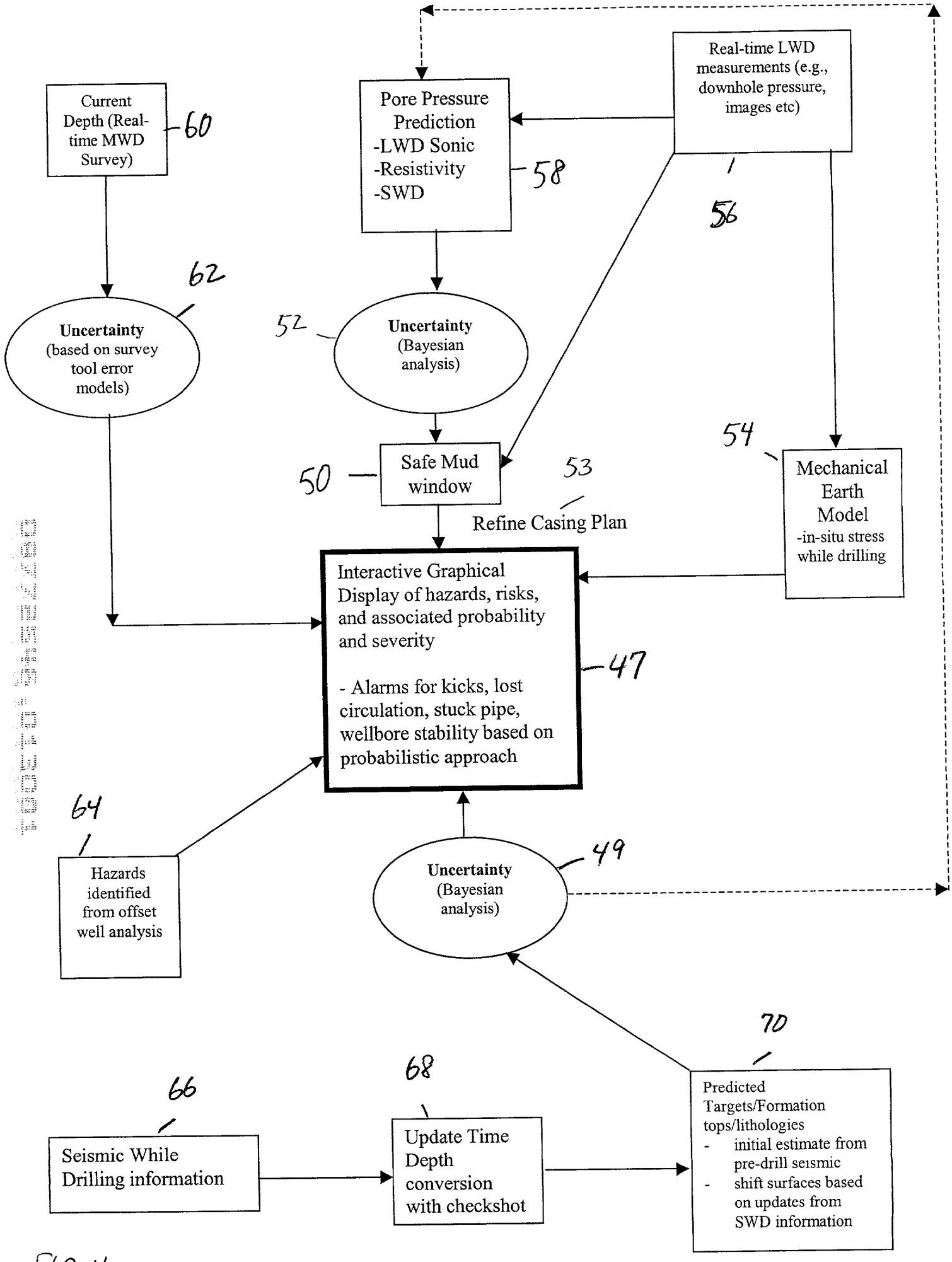
Real-time LWD measurements (e.g., downhole pressure, images etc)
Current Depth (Real-time MWD Survey)
60
Pore Pressure Prediction
-LWD Sonic
-Resistivity
-SWD
58
1
56
62
Uncertainty (based on survey tool error models)
52
Uncertainty (Bayesian analysis)
54
Mechanical Earth Model
-in-situ stress while drilling
50
Safe Mud window
53
Refine Casing Plan
Interactive Graphical Display of hazards, risks, and associated probability and severity
- Alarms for kicks, lost circulation, stuck pipe, wellbore stability based on probabilistic approach
47
64
Hazards identified from offset well analysis
Uncertainty (Bayesian analysis)
49
70
Predicted Targets/Formation tops/lithologies
- initial estimate from pre-drill seismic
- shift surfaces based on updates from SWD information
68
Update Time Depth conversion with checkshot
66
Seismic While Drilling information

FIG 4

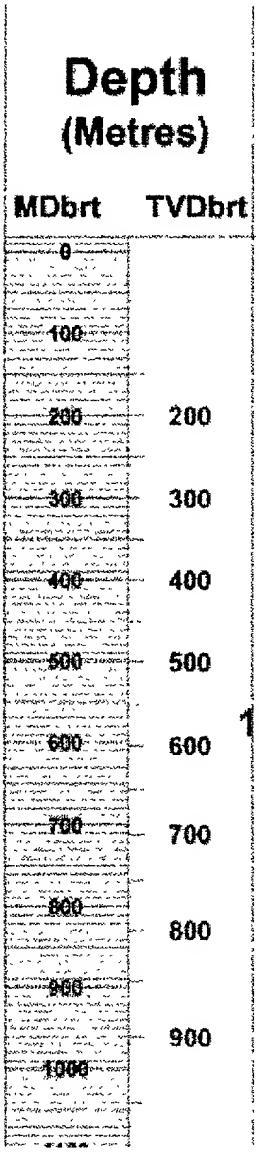
Depth
(Metres)
MDbrt
TVDbrt
0
100
200
300
400
500
600
700
800
900
1000
200
300
400
500
600
700
800
900

FIG 5

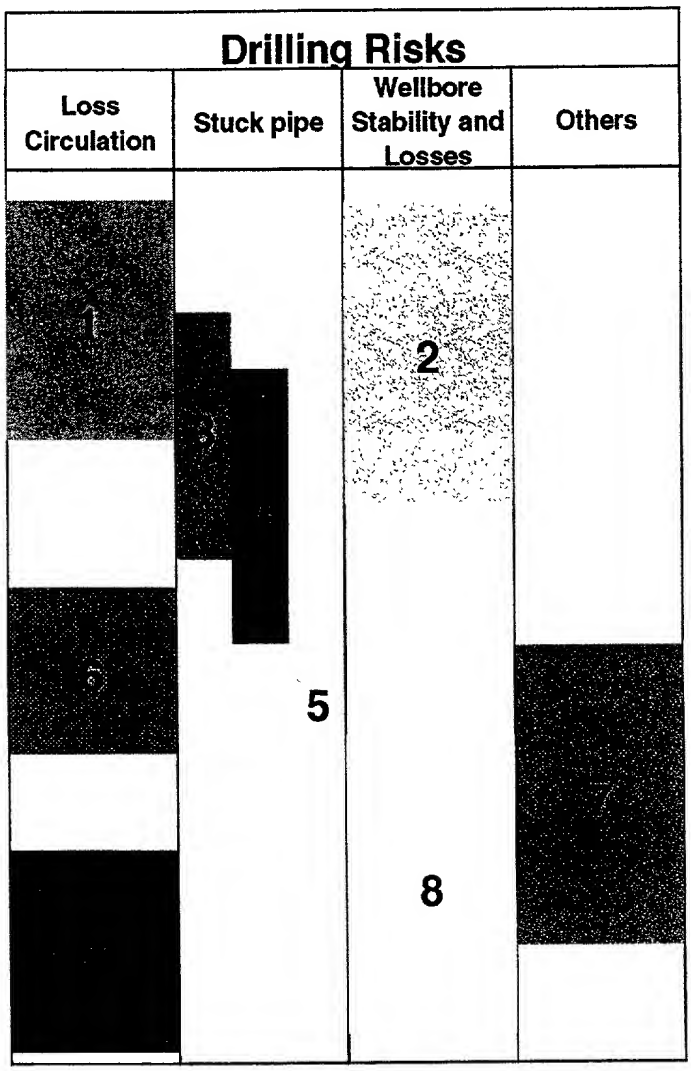
Drilling Risks
Loss Circulation
Stuck pipe
Wellbore Stability and Losses
Others
1
2
5
8

FIG 6

1	1350–1650m	1103–1253.5 m	1) Potential MUD LOSSES using 1.65sg mud weight.	– Keep ECD low – Observe for losses – LCM may be necessary – Maintain good hole cleaning
2	1025 – 1900 m	941 – 1394 m	2) Well inclination between 55–65 deg. Possible AVALANCHING cuttings beds.	– Ensure good hole cleaning and careful tripping of BHA through and below this zone.
3	1675– 1828 m	1266– 1351 m	3) Potential MUD LOSSES if ECD exceeds 1.68sg	– Keep ECD low (<1.68sg) – Observe for losses – LCM may be necessary
4	1850 – 2070 m	1364 – 1505 m	4) Potential BREAKOUT using 1.65 sg mud weight	– Monitor caving volumes – Observe caving morphology – Avoid swabbing during TOH – Good hole cleaning important
5	1980 – 2505 m	1444.5 – 1844.5 m	5) Potential losses due to FAULT ZONE	– Keep ECD below 1.70sg. – Monitor mud losses carefully. – Monitor for fracture related cavings. – An increase in mud weight NOT recommended due to destabilisation of failed material across fault zone. – Do not rotate BHA across fault zone.
6	1990– 2070 m	1450– 1500 m	6) Possible Bedding Parallel Formation Failure. High volumes of cavings, danger of packoff	– Monitor caving morphology for bedding parallel failure – Maintain good hole cleaning, reduce ROP if caving volume becomes excessive with increased hole cleaning. – Do not increase mud weight
7	2725– 2850 m	2040– 2157 m	7) Potential BREAKOUT using 1.65 sg mud weight	– Monitor caving volumes – Observe caving morphology
8	2883 – 2925 m	2189 – 2228 m	8) Potential mud losses in fractured Balder/Sele if ECD exceeds 1.68 sg.	– Keep ECD low (<1.68 sg) – Observe for losses – LCM may be necessary

FIG 7

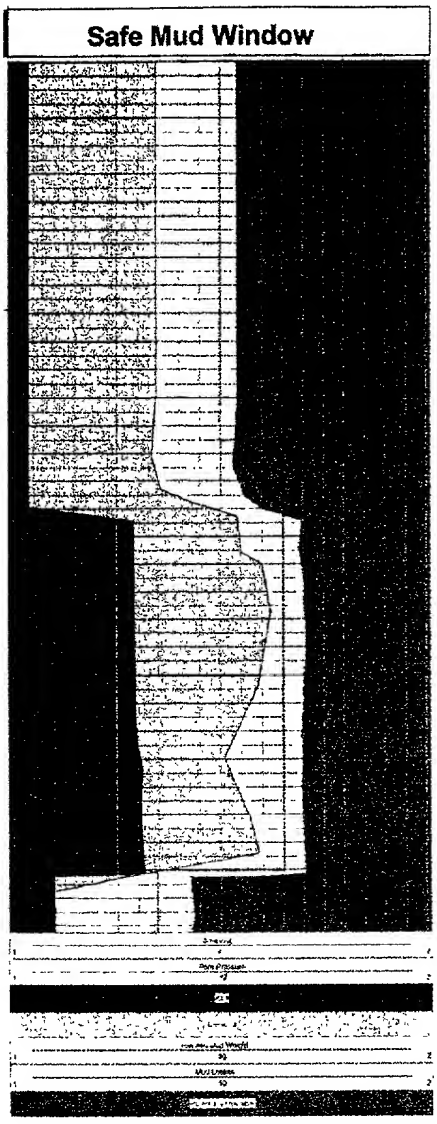

FIG 8